

10/571868

IAFC Rec'd PCT/PTO 14 MAR 2006

Attorney Docket No. 2003P01328WOUS

CERTIFICATION OF ATTACHED ENGLISH TRANSLATION OF PCT  
APPLICATION:

PCT/EP2004/010404 based on DE 103 42 763.5 filed 09/16/2003

I hereby certify the English translation attached is a true and accurate copy of the referenced  
PCT/EP2004/010404 application.



---

John T. Winburn  
March 14, 2006  
Reg. No. 26,822

GAS BURNER FOR LIQUID FUELS

The invention relates to a gas burner for liquid fluid, especially vegetable oil. The gas burner comprises an evaporator for evaporating the liquid fuel. An evaporation chamber of the  
5 evaporator is limited by a limiting wall which has a gas discharge channel to produce a gas jet.

A generic gas burner is known from DE 101 61 154. The gas cooker has a burner operated with liquid fuel, preferably vegetable oil. The burner is provided with an evaporator which is  
10 connected to an intake pipe for the fuel. The evaporator is provided with a gas discharge channel which is directed towards a baffle device for the gas/air-gas mixture. In the burner operated with liquid vegetable oil fission and recombination processes of the vegetable oil can take place during the evaporation process. In this case, cracking products are produced, forming deposits in the evaporator and at the gas discharge channel. These must be removed  
15 after operation of the burner to avoid any blockage of the gas discharge channel.

The object of the invention is to provide a gas burner for liquid fuel which can be operated reliably.

20 The object is solved by a gas cooker having the features of claim 1. According to the characterising part of claim 1, the evaporator is embodied at least as double-walled with an inner wall and an outer wall. The two walls can be made of different materials to fulfil different functions. for example, it is favourable if the inner wall consists of a chemically inactive material such as stainless steel. The outer wall of the evaporator can preferably  
25 consist of a heat-conductive material such as copper.

It is preferable if the gas discharge channel has an opening edge which tapers from the evaporation chamber. This avoids a sharp-edged transition from the limiting wall of the evaporator into the gas discharge channel. Thus, fewer deposits can settle in the orifice area of  
30 the gas discharge channel.

The constriction point of the gas discharge channel is preferably embodied in the inner wall of the evaporator. In this way, both the inlet opening edge and also the constriction point of the gas discharge channel, which are both critical in relation to deposits, can be constructed only in the inner wall of the evaporator which is favourable in terms of production engineering. In this particular arrangement of the constriction point gas creep flows can also be avoided by an annular gap which can be produced during manufacture of the evaporator between opposite boundary surfaces of the inner wall and the outer wall.

According to an advantageous embodiment, the tapering opening edge of the gas discharge channel can be constructed as conical. The opening edge preferably as a cone angle between  $50^\circ$  and  $70^\circ$ . This ensures a particularly smooth transition between the evaporator boundary wall and the gas discharge channel.

The tapering opening edge of the gas discharge channel can go over into the constriction point. The constriction point is advantageously constructed as hollow-cylindrical. In order to achieve a largely stable constriction behaviour of the constriction point, the constriction point advantageously extends over a certain length in the axial direction. On the other hand, such an elongated constriction point results in increased deposits in the gas discharge channel. The length of the constriction point is particularly advantageously about 0.5 mm. The deposits in the area of the gas discharge channel are thereby reduced whilst maintaining a sufficiently stable constriction behaviour.

It is fluid-dynamically advantageous if the gas jet emerges from the gas discharge channel in a conical shape. This ensures good mixing of the emerging gas jet with the ambient air. For the production of a conical gas jet it is advantageous if the outlet opening of the gas discharge channel is expanded in a conical fashion. In this case, a cone angle of the channel outlet opening is preferably greater than a cone angle of the emerging gas jet in order to reduce flow losses.

The evaporator can be embodied as an evaporator tube which can extend through a flame area of the burner. This ensures reliable evaporation of the liquid fuel.

It is preferable if a gas jet opening is constructed in the outer wall of the evaporator, its flow cross-section being greater than that of the constriction point. If the diameter of the constriction point is 0.4 mm, the gas jet opening in the outer wall can well have a diameter of 2 to 4 mm.

5

In a method of manufacturing the gas discharge channel, a first hole serving as the gas discharge channel and an opposing second hole are drilled in the boundary wall of the evaporator. An opening edge of the first hole which opens into the evaporator chamber is then chamfered by means of a drilling tool which is guided through the second hole. The second

10

Two exemplary embodiments of the invention are described hereinafter with reference to the appended drawings. In the figures:

15 Figure 1 is a highly schematic perspective view of a vegetable oil cooker;

Figure 2 is an enlarged section view of a detail X from Figure 1; and

Figure 3 is a view according to Figure 2 according to the second exemplary

20

embodiment.

A gas burner operated with vegetable oil is shown highly schematically in Figure 1. The gas burner has a container 1 filled with liquid vegetable oil. The container 1 is provided with an air pump 3 with which a pressure in the container 1 can be increased. The liquid vegetable oil can be guided at an overpressure in the container 1 via an intake pipe 5 to a coiled evaporator pipe 7. The coiled pipe 7 is constructed as double-walled and has an inner pipe 9 and an outer pipe 11. The coiled evaporator pipe 7 is in fluid-dynamic communication via both of its ends with a cap 6 which is screwed to one end of the intake pipe 5 in a liquid-tight fashion.

25

30 The two ends of the inner pipe 9 project over the corresponding ends of the outer pipe 11. The coiled evaporator pipe 7 is thus fixed to the cap 6 only via by means of the ends of the inner pipe 9 which is advantageous from the production engineering point of view. The nested tubes

9, 11 are formed into two symmetrical loops 13, 15 which are arranged in a V shape with respect to one another. A gas discharge channel 17 is drilled in the coiled loop 7 in a transition section between the two loops 13, 15. This channel is directed towards a baffle plate 19 located at a distance therefrom.

5

Both the coiled evaporator pipe 7 and the baffle plate 19 are held within a hollow cylindrical flame conducting sheet 21 shown by the dashed line in Figure 1. In this case, an upper edge of the flame conducting sheet 21 can serve as a placement surface for a food container. A pressure-reducing valve 23 which can be used to adjust the heating power of the gas burner is incorporated in the intake pipe 5.

10

Figure 2 shows an enlarged side sectional view of the gas discharge channel 17. The gas discharge channel 17 has a hollow cylindrical constriction point 27 which extends in an axial direction A of the gas discharge channel 17 over a length d of about 0.4 mm. The gas discharge channel 17 projects into an evaporator chamber 29 bounded by the inner pipe 9. Both the inner pipe 9 and the outer pipe 11 have a wall thickness w of about 1 mm. The gas discharge channel 17 has an opening edge 31 which tapers starting from the evaporator chamber 29 in a gas flow direction. The tapering opening edge 31 of the gas discharge channel is constructed as conical and has a cone angle  $\alpha$  of 60°. The outer pipe 11 on the other hand has a gas jet opening 33 on the output side of the gas outlet channel 17. This is constructed as having a diameter a of about 2 to 4 mm and is thus many times larger than a diameter of the constriction point 27 of about 0.4 mm.

15

20

The pipes 9, 11 are placed inside one another before being bent to form the coiled evaporator pipe 7. In this case, a small annular gap 39 can form between the opposing boundary surfaces 35, 37 of the two pipes 9, 11, as indicated in Figure 2. Disadvantageous gas creep flows can flow out of the gas discharge channel 17 through the annular gap 39.

25

For operation the burner must first be ignited by means of an external ignition device which is not shown. External ignition is necessary because the ignition point for vegetable oil lies in the range of 300°C. The ignition device can operate with kerosine or diesel oil for example whose ignition point is only about 50°C. The ignition device preheats the coiled evaporator

30

pipe 7 for 30 seconds for example to start a combustion process. The heat thus produced is sufficient to start the evaporation process in the coiled evaporator pipe 7 and to ignite a gas flow emerging from the gas discharge channel 17. In order to maintain a combustion process, a drop in pressure in the container 1 must be compensated by occasionally actuating the air pump 3.

In an orifice area of the gas discharge channel 17 inside the evaporation chamber the gas pressure can increase to about 3 bar whereby a gas jet G is expelled from the gas discharge channel 17 at high speed. The gas jet G emerging from the gas discharge channel 17 is shown by dashed lines in Figure 2. The gas jet G in the form of a cone having a cone angle between 15°-20°, is blown out of the evaporation chamber 29 via the gas discharge channel 17 into a gas/air mixing zone 41. The gas/air mixing zone 41 is bounded by the baffle plate 19 at the top. This ensures good mixing of the gas jet G with the ambient air U which is guided at the bottom through the flame conducting sheet 21 into the mixing zone 41. The baffle plate 19 brings about an increase in the residence time of the gas/air mixture in the mixing zone 41 and holds the flame produced in the region of the evaporator loops 13, 15. The heat produced in the evaporator loops 13, 15 in this case is sufficient to maintain the evaporation process in the coiled evaporator loop and to supply sufficiently evaporated vegetable oil to the gas discharge channel 17.

As a result of the tapered opening edge 31 of the gas discharge channel 17, a deflection of the gas flow from the evaporation chamber 29 into the gas discharge channel 17 indicated by the arrows in Figure 2 is achieved free from flow losses. Such a deflection is important for reliable burner operation because of the material properties of the vegetable oil: vegetable oil consists of long-chain glycerides of fatty acids so that its viscosity is between 20 and 30 times higher than that of petroleum for example. During fission and recombination processes of the vegetable oil during the evaporation phase cracking products can be formed and settle as deposits on the gas discharge channel 17 and in the coiled evaporator pipe 7. These must be removed after the cooking process to avoid blockages in the gas discharge channel. As a result of the smooth transition according to the invention from the limiting wall bounding the evaporation chamber 29 via the tapering opening edge 31 into the constriction point 27 of the gas discharge channel 17, these deposits can only settle in the area of the gas discharge

channel to a reduced extent. The burner can nevertheless operate reliably with a reduced cleaning requirement for the evaporation chamber 29.

For cleaning the evaporation chamber 29 the coiled pipe 7 with its cap 6 is first unscrewed  
5 from the intake pipe 5. A cleaning brush can then be passed through the coiled pipe 7.

As shown in Figure 2, the gas jet opening 33 in the outer pipe 11 is many times larger than the diameter of the gas discharge channel. As a result, the annular gap 39 formed between the boundary surfaces 35, 37 of the pipes 9, 11 is located outside the gas jet G emerging from the  
10 constriction point 27. There is thus no need to fear that a fraction of the gas jet G is diverted as a creep flow into the annular gap 39 and can escape at the free ends of the outer pipe 11.

As is indicated in Figure 2, most of the gas expelled from the gas discharge channel 17 is located inside the gas jet cone shown in Figure 2. The arrangement of the annular gap 39  
15 outside the gas jet cone reliably prevents a significant quantity of gas from being able to penetrate into the annular gap 39 and flow through the annular gap 39 as a gas creep flow.

To produce the coiled evaporator pipe 7, the two elongated pipes 9, 11 are placed inside one another. The coiled evaporator pipe 7 is then bent helically with the two evaporator pipe loops  
20 13, 15 as shown in Figure 1. The gas discharge channel 17 is then drilled in a transition section between the two evaporator loops 13, 15. For this purpose a first drill hole 47 is drilled in the coiled evaporator pipe 7 from a lower side using a first drilling tool 45 as shown in Figure 2 and then countersunk on the opposite side of the subsequently formed opening edge 31 of the gas discharge channel. In a further process step the countersunk region 31 is drilled  
25 through to form the constriction point 27 using a second, smaller drilling tool 49 having a diameter of about 0.4 mm. The gas jet opening 33 in the outer pipe 11 can already be drilled before the two pipes 9, 11 are inserted inside one another. In a further process step a closure plate 51 is soldered to the outside of the outer pipe 11 to close the bore hole 47.

30 Figure 3 shows a further embodiment of the gas discharge channel 17 according to the second exemplary embodiment. The gas discharge channel 17 from Figure 3 can also be used in the gas burner from Figure 1. Unlike Figure 2, the conical opening edge 31 of the gas discharge

channel 17 which tapers from the evaporation chamber 29 goes over directly in a conically expanding outlet opening edge 51. In this case, a circular constriction point 27 is formed at the acute-angled transition between the inlet opening edge 31 and the outlet opening edge 51. In contrast to figure 2, this has no significant extension in the axial direction A.

5

As in Figure 2, the constriction point 27 according to Figure 3 is also arranged in the gas flow direction before the annular gap 39. A cone angle  $\beta$  of the outlet opening edge 51 is about  $40^\circ$  in this case. The gas cone G on the other hand occupies a cone angle  $\gamma$  of about  $20^\circ$ . The annular gap 39 is thus sufficiently distant from the emerging gas jet G so that this flow past  
10 the annular gap 39 into the mixing area 41.